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ABSTRACT

A study gathered information from the manufacturing world about its perception and evaluation of identified industrial arts/technology education competencies. It determined whether industrial arts/technology educators and manufacturing production managers thought significantly differently about the importance of competencies acquired in a secondary industrial arts/technology education program. Data were collected from 132 production managers of manufacturing companies throughout the United States and compared with data received from 55 teacher educators. Data analyses created a reliability coefficient matrix, determined alpha levels for each group of competencies, and compared the evaluations through a group analysis. Both educators and industrial managers rated interpersonal skills, oral communication skills, and problem-solving techniques high. In all three competency areas of attitudes, skills, and knowledge, educators and managers rated characteristics of individuals higher than specific occupational skill competencies. Managers thought significantly differently about the importance of attitude, value, and interest competencies. Educators evaluated knowledge competencies as the lowest category of the three and managers evaluated this category significantly lower. (YLB)

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A Comparative Study of Industrial Arts/Technology Education Competencies Between Industrial Teacher Educators and Production/Plant Managers of Manufacturing Industries

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Introduction

To keep competitive in education, teacher educators must study the past, analyze existing phenomena and project with accuracy into the future. "Workforce 2000, Work and Workers for the 21st Century," in part, discusses the forces shaping the American economy and the changes in workers into the year 2000. Industrial Arts/Technology education programs must have data from many facets of our economy in order to develop futuristic curriculum that is meaningful to students. One of the ways to develop meaningful curriculum for students in industrial arts/technology education is to identify and compare competencies associated with a facet of industry.

In the document, "The Unfinished Agenda," technological literacy, broad skills and knowledge goals were important issues that needed to be specifically addressed to industry. Industrial information should play a bigger role in the educating of secondary students. Teacher educators in the industrial arts/technology education field should understand industry from the technical and administrative side, while all levels of industrial managers should understand the breadth and depth of the industrial arts/technology education field. Better communications between the trade industries and universities for long-range planning of curriculum should be established to enhance the sharing of technical expertise (Hollinger, 1984).

This study was an attempt to gather information from the manufacturing world about their perception and evaluation of identified industrial arts/technology education competencies.

Purpose of Study

The purpose of this study was to take secondary industrial arts/technology education competencies that were identified by post-secondary industrial teacher educators and compare their rating of importance to the rating of the same competencies by production managers from manufacturing companies. Production managers were contacted by mail to determine their rating of the competencies that they thought should be included in an industrial arts secondary school curriculum.

Statement of the Problem

The problem of this study was to determine if industrial arts/technology educators and manufacturing production managers thought significantly different about the importance of acquired competencies in a secondary industrial arts/technology education program.

Objectives

The study was designed to meet the following objectives:

1. Collect data from production managers of manufacturing companies.

2. Compare data received from production managers to data received from industrial teacher educators.
3. Run test of significance on data comparisons.

Need for the Study

In the 1960's, industrial arts experienced an influx of innovative programs. Many of those programs clustered subject matter and classroom activities and presented a new approach to the teaching of industrial arts content (Maley, 1975). Approximately twenty years have gone past and most of these programs, as originally conceived, are not functioning.

Now, in the 1980's a rebirth of the conceptual idea of clustering subject material and activities has arose under the term of technology education. With some variations, construction, manufacturing, communication, and power/energy/transportation are the four most common clusters identified.

The bases of the content for both the 60s and 80s periods of curriculum development was extracted from industry. Industrial arts/technology education is a study of the technical means by which industry functions. In the specific case of the area called manufacturing or production, teacher educators have usually been asked to identify and determine the importance of competencies. More information needs to be gathered in the manufacturing area from industrial managers of production to determine the

relationship of the competencies used in industry and the competencies taught in a basic industrial arts education program.

Limitations

The data collected from industrial managers was limited to production type industries. The respondents were industrial plant/production managers. The data was then compared to data received by teacher educators listed in the Industrial Teacher Education Directory.

Approach

Design

Based on the nature of the objectives and resources available, an evaluation instrument developed by the Delphic Technique (Nelson, 1985) was mailed to production managers of manufacturing companies throughout the United States. The manager's information was used in a comparative analysis with data received from industrial teacher educators from the same evaluation instrument used in 1985.

Population and Sample

One of the populations was identified for the study because of the nature of their positions of management in the production area. A random sample of production managers from 500 manufacturing companies were selected to take part in this study. Five-hundred manufacturing companies that belonged to Dunn's Million Dollar Club were selected because of their custom, job lot, or line production characteristics. Production managers were

selected as the individuals most familiar with the competencies most desired for workers in the production area.

Three weeks after the initial instrument was mailed, a post card reminder was sent to those companies not responding. An additional list of qualifying companies was kept for the purpose of back up for those instruments that were returned because of non-deliverable mail due to plant closings.

Evaluation Instrument

With permission of Dr. Orville Nelson from the University of Wisconsin-Stout, the same evaluation instrument used for teacher educators was also used for the production managers in industry. The instrument was divided into three main categories. These categories were knowledge, attitudes and interests, and skills. Based on managers' knowledge and skills of their profession, each one was to evaluate competency statements as to the relevancy of industrial education curriculum applicable to competencies that are required by production employees.

Data Analysis

The data were received and analyzed in the following manner:

1. Data was verified for missing items.
2. Correlation matrix was run to find unacceptable alpha number (above 85 acceptable).
3. Mean and standard deviation for each competency was calculated.

4. Test of significance was run for the knowledge, attitudes and interest, and the skill groups between teacher educators and production/plant managers.

Results

The data were analyzed in four groups. The first analysis was to create a reliability coefficient matrix and determine alpha levels for each group of competencies used in this study. This is represented in Table I entitled Reliability Analysis.

The second analysis of data was taken from the study conducted by Dr. Orville Nelson on teacher educators. The data for teacher education was represented in Tables II, III, and IV, column entitled Teacher Educators.

The third analysis was completed on data which was supplied by one hundred and thirty-two industrial plant/production managers. This data was represented in Tables II, III, and IV, column entitled Industrial Managers.

The fourth analysis of data was to compare the evaluations from teacher educators with the evaluations received from industrial production/plant managers and to determine whether teacher educators thought significantly different as a group from the group of production managers on the three identified areas of competencies.

Due to the nature of the dependent type variables, a separate test of significance was not possible on each competency because it could have produced a Type I error in excess of twenty percent.

Therefore group analysis was used to maintain reliability at the .05 level.

Insert Table 1 about here

The analysis of data indicated a significant difference in the evaluations of competencies between industrial teacher educators and production/plant managers in all three competency categories. The data also indicated common competencies that were rated high and some rated low by both types of respondents. The data also identified differences on individual competency statements that should raise questions about industry's relationship with education and education's relationship with industry. The higher scores from educators would be somewhat expected due to the importance educators place on the content being taught.

Commonalities

There were several competencies that both industry and educators rated very high. Educators and industrial managers felt strongly about the importance of interpersonal skills--the ability to work effectively with others and also to be able to work cooperatively with others. The ability to use oral communication and problem-solving techniques were also valued highly.

In all three competency areas of attitudes, skills and knowledge, educators and industrial managers rated characteristics

of individuals higher than specific occupational skill competencies.

Attitudes, Values & Interest

Significant Differences

Industrial production/plant managers thought significantly different than educators about the importance of attitude, value and interest competencies. Both educators and managers gave over-all ratings of four or more which puts them into the important category. Educators and production/plant managers rated attitude, value and interest competencies higher than the knowledge and skill competencies categories. (See Table 5).

Individual Differences

In the attitude, values and interest group there were four competency statements that appeared to have had great differences. Some of these differences are understandable because of the differences in settings. However, certain questions could be raised about the perception either population might have about a certain statement.

The greatest difference was indicated in the competency statement of interest in student organizations. The teacher educators' mean for this statement was 3.31 and the production/plant managers' mean was 2.45 (dif. .86). The interest in learning about technology statement received a mean of 4.36 from teacher educators and a mean of 3.60 from the production/plant managers (dif. .76). The positive attitude

towards profit statement received a mean of 3.44 from teacher educators and a mean of 4.17 from production/plant managers (dif. .73). The last competency statement that appeared to have great differences was the desire to do it right the first time with a mean of 3.93 from teacher educators and a 4.65 from production/plant managers (dif. .72). (See Table 2).

Skills

Significant Differences

Both the educators and the industrial production/plant managers gave skills a moderate importance to important rating. The teacher educators, however, evaluated skill competencies significantly higher than the ratings from the industrial production/plant managers. (See Table 5).

Individual Differences

In the individual comparisons of the skill competencies, there were three statements that appeared to have had great differences. The teacher educators' mean was 4.89 for the statement of drafting fundamentals including CAD while the production/plant managers' mean was 3.00 (dif. .89). The teacher educators' mean for the statement on study skills was 4.22 while the production/plant managers' mean was 3.37 (dif. .85). The last statement in this category appearing to have had great differences was the finding and using technical information. The teacher educators' mean for

this statement was 4.36 while the production/plant managers' mean was 3.57 (dif. .79). (See Table 3).

Knowledge

Significant Differences

Teacher educators evaluated knowledge competencies as the lowest category of the three and industrial production/plant managers evaluated this category significantly lower. (See Table 5).

Individual Differences

There were eleven competency statements in the knowledge category that appeared to have had great differences. The teacher educators' mean was 3.93 for the statement of career opportunities in industrial arts teaching while production/plant managers' mean was 1.85 (dif. 2.08). The transportation concepts statement received a mean of 3.89 by the teacher educators and a mean of 2.72 from production/plant managers (dif. 1.17). The role and impacts of technology in our world competency statement received a mean of 4.55 from teacher educators and a mean of 3.40 from production/plant managers (dif. 1.15). The teacher educators' mean was 3.45 for the statement of entrepreneurship-procedures and problems in starting your own business while the production/plant managers' mean was 2.33 (dif. 1.12). The basic construction concepts statement received a mean of 3.91 from teacher educators and a mean of 2.92 from production/plant managers (dif. .99). A mean of 4.27 by teacher educators was given to the statement about

basic applications of science in technology and a mean of 3.35 was given to this statement by production/plant managers (dif. .92). The teacher educators' mean for the basic energy concepts statement was 4.04 while the mean of the production/plant managers was 3.13 (dif. .91). The free enterprise system statement received a mean of 3.75 from teacher educators and a mean of 2.93 from the production/plant managers (dif. .82). The statement of how industry is organized and functions received a mean of 4.04 from the teacher educators and a mean of 3.22 from the production/plant managers (dif. .82). The teacher educators' mean for the statement concerning basic drafting techniques and concepts was 3.93 while the production/plant managers' mean was 3.15 (dif. .78). The last statement that appeared to have had great differences between the two groups of respondents was career opportunities in technical occupations. This statement received a mean of 4.16 from teacher educators and a mean of 3.43 from the production/plant managers. (See Table 4).

Summary

The analysis of data from this study has raised many questions in the mind of this writer. Are the competencies of industrial arts of the past really much different from what is valued today? According to this study, there is a combination of old established competencies blended in with new ones that are evaluated as being important. Attitudes, skills and knowledge, in

that order of importance, seem to raise questions about curriculum direction and depth of study.

It seems that upon closer examination of individual differences between the ratings of statements, many questions should be explored. Some of these questions are:

1. Should industrial arts/technology education focus on those competencies that are rated high by both educators and managers?
2. Why are there some competencies rated high by educators and low by industrial production/plant managers?
3. Why are there some competencies rated high by industrial production/plant managers and low by educators?
4. Do educators and industrial managers have the same definition of terms used in describing competencies?
5. Do teacher educators actively pursue involvement with industry and what should industry know about industrial arts/technology education programs?
6. How much of an industrial arts/technology education curriculum should be conceptual learning and how much should be skill development?
7. Do educators and industrial production/plant managers have different definitions of skill development?
8. Why don't industrial managers value industrial arts teaching careers very high?

9. Do industrial managers understand changes that have taken place in the past several years?
10. What does the new technology education curriculum terminology mean to industrial production/plant managers?
11. Should standards of performance in industrial arts/technology education conform to the design of industry?

Recommendations

The first recommendation should be to carry on further studies with other areas of industry to determine futuristic industrial arts/technology education competencies. Secondly, the competencies that were rated high or low by both respondents should be analyzed carefully. Thirdly, competency statements that appeared to have great differences should be analyzed to determine why respondents answered in that manner. The last recommendation would be to run further studies on those competency statements that appeared to have great differences to determine if there was a statistical significant difference between the two groups of respondents.

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Table 1

Reliability Analysis

Competency Groups	Alpha Level
Attitudes, Values & Interest 1-19	.8709
Skills 1-18	.9155
Knowledge 1-28	.9043

< .85 = Accept Reliability

1 = Not Important
2 = Slight Importance
3 = Moderate Importance
4 = Important
5 = Very Important

Table 2

Competencies	Teacher Ed. N = 55			Ind. Man. N = 132			
Attitude, Values & Interests	Rank	$\bar{X}$	SD	Rank	$\bar{X}$	SD	$\bar{X}$dif.
Responsibility	1	4.84	.37	3	4.59	.53	.25
Interpersonal skills--ability to work effectively with others	2	4.71	.53	5	4.51	.68	.20
Honesty	3	4.65	.67	1	4.72	.48	.07
Interest in learning	4.5	4.60	.60	12	4.13	.83	.47
Self-confidence and self-esteem	4.5	4.60	.63	10	4.22	.76	.38
Pride in their work	6	4.55	.69	4	4.57	.65	.02
Self-discipline	7	4.49	.57	9	4.25	.60	.24
Interest in working cooperatively with others	8	4.45	.57	7	4.32	.72	.13
Positive attitude toward safety	9	4.44	.71	6	4.44	.60	.00
Respect for other people and their views	10	4.42	.81	13	4.07	.77	.35
Mental set that encourages curiosity	11	4.40	.68	15	3.86	.71	.54
Interest in learning about technology	12	4.36	.75	16	3.60	.88	.76
Appreciation of the importance of work	13	4.22	.76	8	4.31	.71	.09
Interest in technical careers	14	4.00	.77	17	3.32	.90	.68
Desire to "do it right the first time"	15	3.93	.00	2	4.65	.66	.72
Interest in design and aesthetics	16	3.84	.74	18	3.18	.76	.66
Appreciation of craftsmanship	17	3.80	.90	14	4.00	.79	.20
Positive attitude toward profit	18	3.44	.98	11	4.17	.66	.73
Interest in student organizations	19	3.31	.63	19	2.45	1.07	.86
		$\bar{\bar{X}}$ = 4.268			$\bar{\bar{X}}$ = 4.077		

1 = Not Important
2 = Slight Importance
3 = Moderate Importance
4 = Important
5 = Very Important

Table 3

Competencies	Teacher Ed. N = 55			Ind. Man. N = 132			
Skills	Rank	$\bar{X}$	SD	Rank	$\bar{X}$	SD	$\bar{X}$dif.
Problem solving	1	4.80	.40	1	4.41	.73	.39
Competency in working with people	2	4.60	.60	4	4.36	.60	.24
Effective work habits	3	4.56	.60	2	4.40	.59	.16
Communicating effectively (writing and speaking)	4	4.45	.74	3	4.37	.73	.08
Applying math and science to technical problems and tasks	5	4.44	.74	8	3.77	.88	.67
Finding and using technical information	6	4.36	.65	13	3.57	.95	.79
Using basic tools and machines	7	4.24	.82	1.1	3.66	.99	.58
Safe use of tools and machines	8.5	4.22	.81	7	3.78	1.00	.44
Planning activities and projects	8.5	4.22	.53	9.5	3.74	.93	.48
Study skills	8.5	4.22	.74	16	3.37	.96	.85
Reading technical material with understanding	11	4.18	.67	12	3.58	.90	.60
Evaluating their own work in relation to established standards	12	4.09	.70	5	3.91	.73	.18
Measurement (how to measure)	13	4.07	.79	9.5	3.74	.98	.33
Leadership	14	3.96	.79	6	3.90	.72	.06
Common applications of a computer	15	3.95	.85	14	3.45	.96	.50
Drafting fundamentals including CAD	16	3.89	.83	18	3.00	1.01	.89
Working with common materials	17	3.84	.83	17	3.28	.98	.56
Reading blueprints	18	3.60	.83	15	3.39	1.12	.21
		$\bar{\bar{X}}$ = 4.204			$\bar{\bar{X}}$ = 3.76		

1 = Not Important
2 = Slight Importance
3 = Moderate Importance
4 = Important
5 = Very Important

Table 4

Competencies	Teacher Ed. N = 55			Ind. Man. N = 132			
Knowledge	Rank	$\bar{X}$	SD	Rank	$\bar{X}$	SD	$\bar{X}$dif.
Problem solving techniques	1	4.84	.37	1	4.43	.64	.41
Safe working procedures	2	4.58	.63	2.5	4.25	.90	.33
The role and impacts of technology in our world	3	4.55	.66	17	3.40	1.08	1.15
Written and oral communication techniques and skills used in industry	4	4.36	.73	2.5	4.25	.75	.11
Basic applications of science in technology	5	4.27	.78	18	3.35	.95	.92
Computer applications in industry	6.5	4.22	.81	8	3.69	1.00	.53
Human relations skills	6.5	4.22	.79	4	4.17	.88	.05
New manufacturing systems such as computer computer integrated manufacturing CIM & FMS	8	4.18	.80	9	3.61	1.12	.57
Career opportunities in technical occupations	9	4.16	.74	16	3.43	1.21	.73
Basic applications of math in technology	10	4.15	.70	6	3.74	.95	.41
Communications concepts	11	4.13	.67	5	3.88	.91	.25
Basic materials and processes	12	4.11	.79	15	3.45	.98	.66
Basic manufacturing concepts	13	4.09	.78	7	3.72	.93	.37
Basic technical terms	14	4.05	.73	11	3.56	.96	.49
Basic energy concepts	15.5	4.04	.69	22	3.13	.97	.91
How industry is organized and functions	15.5	4.04	.74	19	3.22	.92	.82
Change--its impact on one's personal life and society; and the need to adapt	17	3.93	.80	10	3.61	.96	.34
Career opportunities in industrial arts teaching	18.5	3.93	.86	28	1.85	1.07	2.08

(Table 4 Continues)

Basic drafting techniques and concepts	18.5	3.93	.79	21	3.15	1.05	.78
Basic construction concepts	20	3.91	.83	24	2.92	1.14	.99
Transportation concepts	21	3.89	.83	25	2.72	1.02	1.17
The free enterprise system	22	3.75	.79	23	2.93	1.26	.82
Basic management techniques	23	3.56	.88	12	3.55	.90	.01
The nature of craftsmanship	24	3.47	.90	20	3.18	1.06	.29
Job-seeking skills	25.5	3.45	1.03	14	3.47	1.13	.02
Entrepreneurship--procedures and problems in starting your own business	25.5	3.45	.80	27	2.33	1.16	1.12
Costing materials, supplies and labor	27	3.42	.92	13	3.52	1.03	.10
The history of tools and technology	28	3.31	.88	26	2.65	.95	.66
		$\bar{X}$ = 3.999			$\bar{X}$ = 3.40		

1 = Not Important
2 = Slight Importance
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4 = Important
5 = Very Important

Table 5

Comparative Analysis

Variables	Group	N	Mean	SD	SE	T Value	Significant Yes	Significant No
Attitude, Values, Interest, etc.	Industrial Production/ Plant Managers	N=132	4.07	.399	.035			
						-3.10	X	
	Industrial Teacher Educators	N= 55	4.27	.349	.047			
Skills	Industrial Production/ Plant Managers	N=132	3.76	.569	.050			
						-5.32	X	
	Industrial Teacher Educators	N= 55	4.20	.350	.047			
Knowledge	Industrial Production/ Plant Managers	N=132	3.40	.531	.046			
						-7.78	X	
	Industrial Teacher Educators	N= 55	3.99	.308	.041			

00.05 Level(1.96)